Hydraulic Wind Power Transfer Technology

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Abstract:

Expiration of renewable energy tax credits in general and a gap in wind energy breakthroughs in particular have caused high cost of wind energy and technological dependency on countries such as China and Germany. Reducing the cost of wind energy requires a paradigm shift that offers simple structures, affordable design, and efficient operation. High performance energy collection, conversion, and storage techniques should therefore be introduced. Earlier solutions were based on hydraulic power transmission for a single turbine as a promising technique to decrease the weight of towers and reduce the construction process and the overall capital investment. Hydraulic techniques have not been widely used probably because of the following reasons: 1) the power transfer efficiency is low in a single turbine-single generator configuration, 2) their operation is hard to control, and 3) they require special design of hydraulic machines, such as pistons and variable displacement pumps.

Recent advancements in large hydraulic equipment and their improved efficiencies have encouraged companies such as Mitsubishi and Chapdrive to invest in onshore and offshore hydraulic driven wind power. However, in their designs, the already existing problems such as the heavy weight of the tower and the efficiency of the overall power transfer systems remain un-resolved.

Proposed in this research is a technology that reduces the capital investment and enhances the overall system efficiency of hydraulic equipment. The technique integrates multiple wind turbines to a central generation unit through hydraulic wind power, and by doing so, it reduces the capital equipment of the entire power plant and substantially increases power transfer efficiency. The system operates when a wind-driven hydraulic pump converts the energy of the wind into a high-pressure medium. The energy of several wind turbines is collected and transferred to a pair of hydraulic pumps coupled with two ground-level generators. The main generator generates power at 60 Hz, while the auxiliary generator stores and releases the energy as required to regulate the wind power and load variations.